

Eureka! Z' Boson at TeV Scale

Jing Li, Qiao-Rong Shen, Dian-Yu Liu,
Ren-Qi Pan, Hai-Jing Zhou, Xiao-Kun Yang
@THU, July 20, 2016

The 3rd International Summer school on TeV Experimental Physics (iSTEP)

Table of Contents

1. Introduction
2. DATA Hierarchy
3. TMVA Section
4. Background Cutting
5. $t\bar{t}$ Background

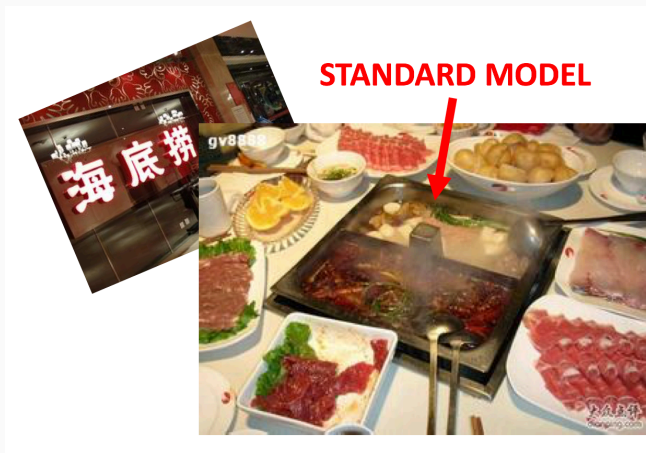
Introduction

Z' Boson

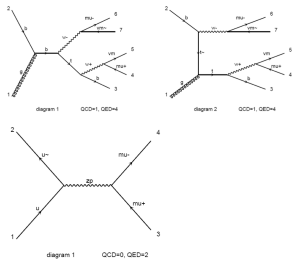
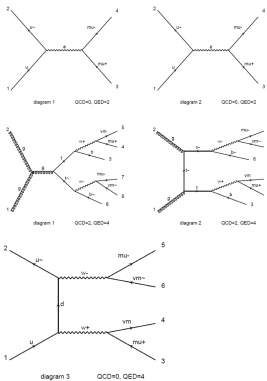
- hypothetical;
- neutral, colorless, self-adjoint, spin-1 gauge boson that is a carrier of a new force;
- might couple to a hidden sector;
- could play a role in supersymmetry breaking or mediation.

Motivation

Aim: new high-mass narrow resonances in dimuon and dielectron invariant mass spectra.



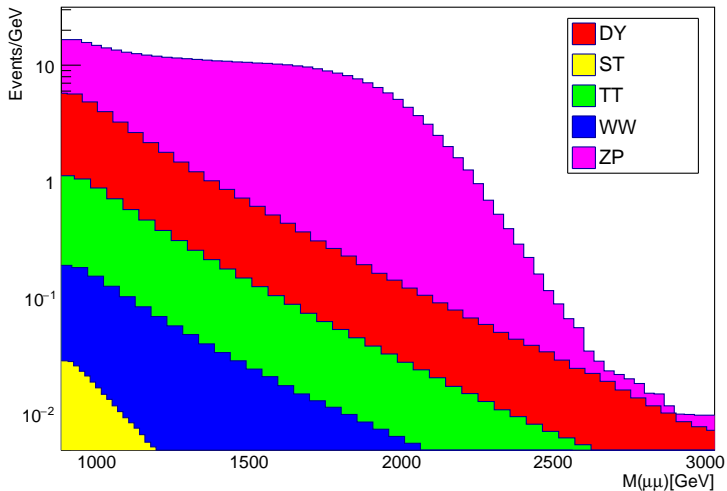
Backgrounds and Signals: DY, TTbar, Diboson, Single top, and our Z' signal



DATA Hierarchy

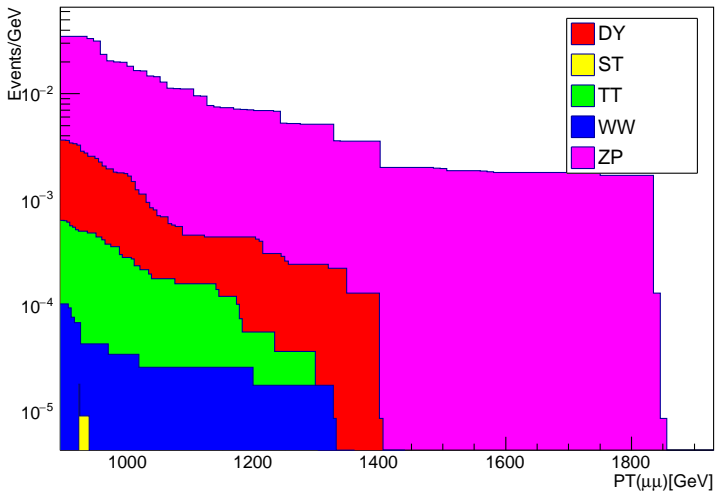
Invariant Mass of Dilepton

Cumulative MII Distribution



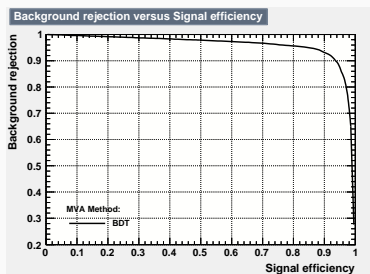
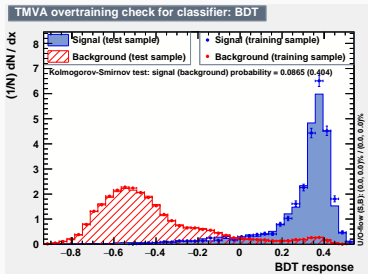
Transverse Momentum of Dilepton

Cumulative PTII Distribution

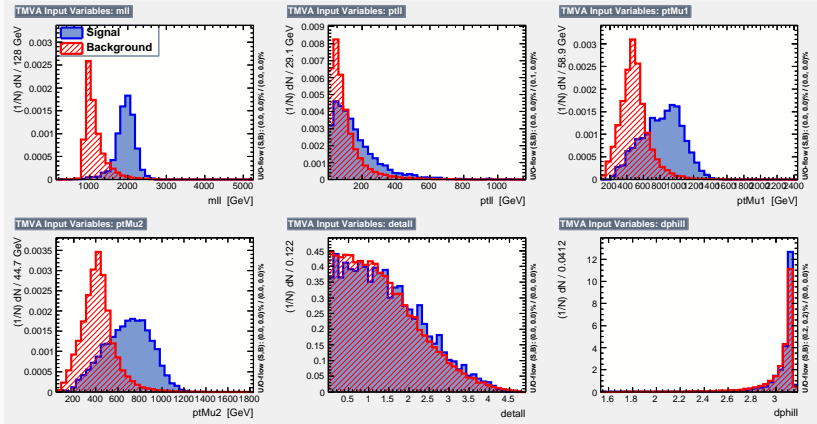


TMVA Section

BDT

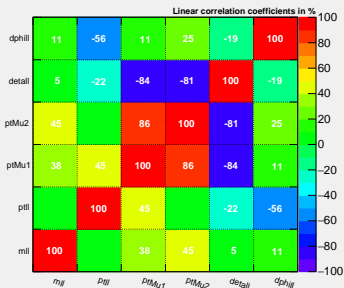


BDT(CONT)

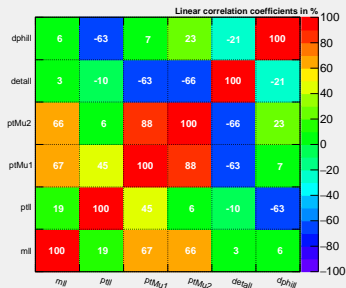


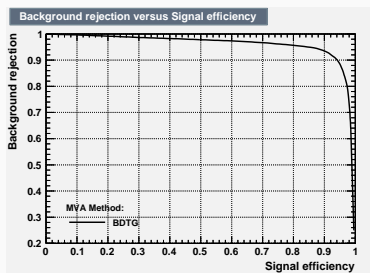
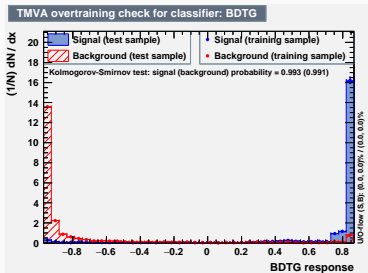
BDT(CONT)

Correlation Matrix (signal)

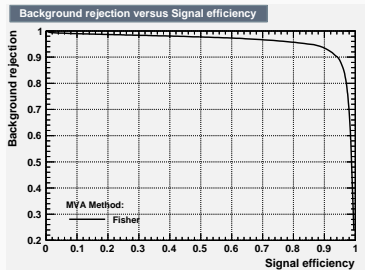
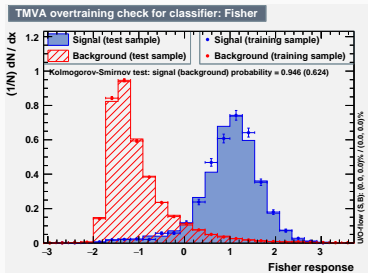


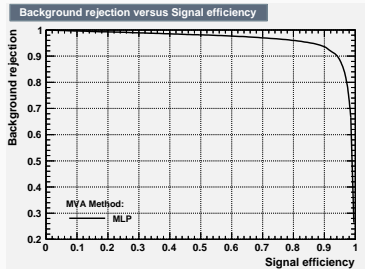
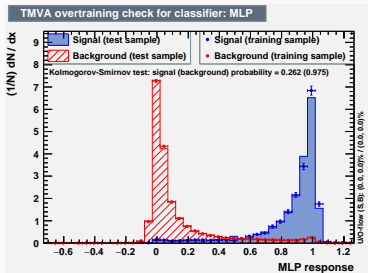
Correlation Matrix (background)



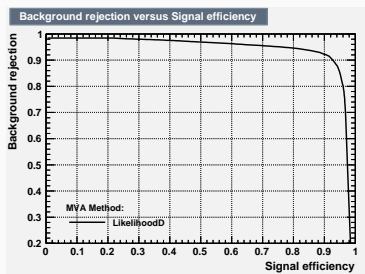
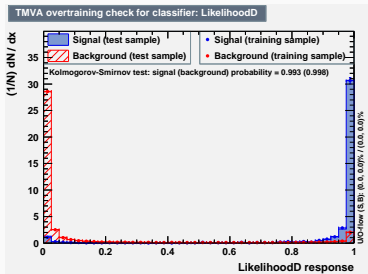


Fisher



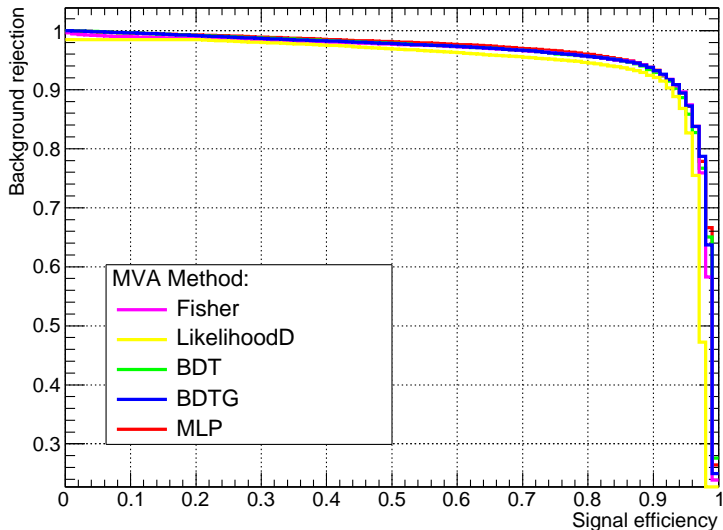


LikelihoodD



TMVA Overview

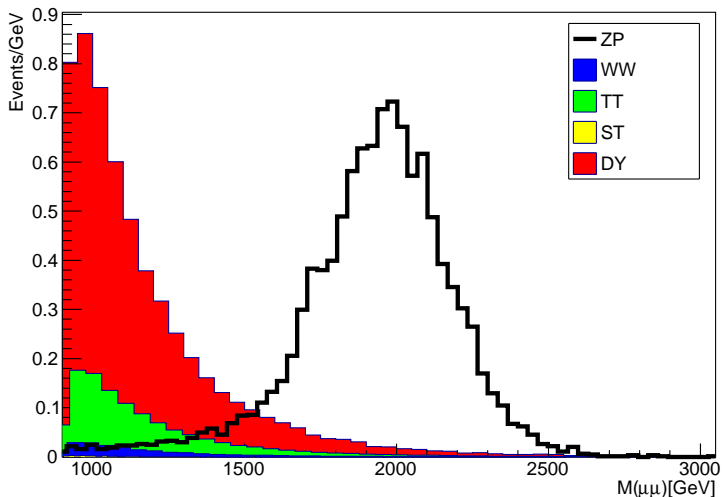
Background rejection versus Signal efficiency



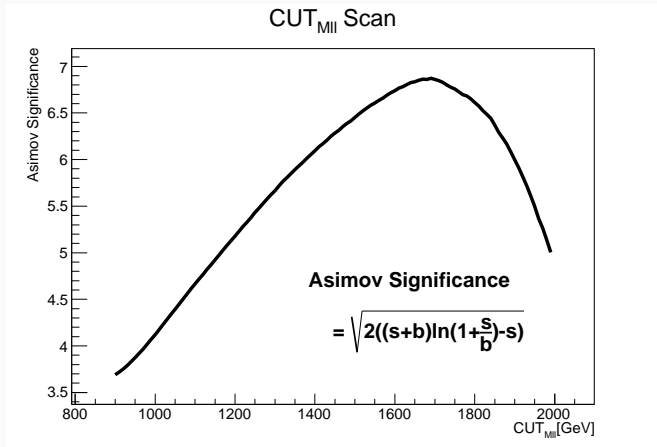
Background Cutting

Background Cutting Optimization

Signal & Background



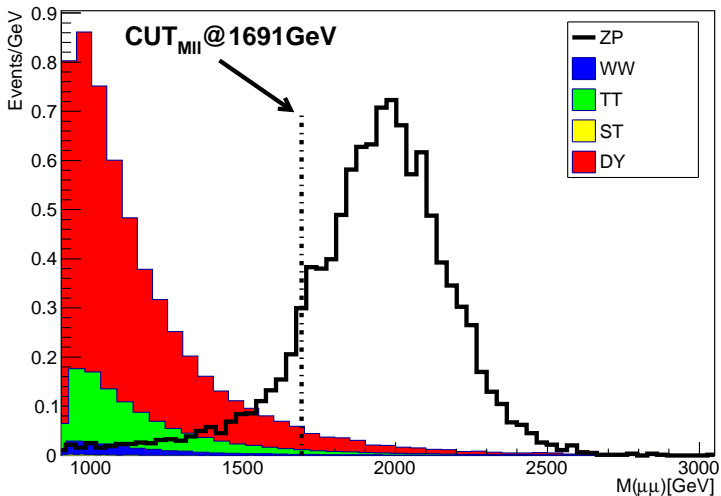
Background Cutting Optimization(CONT)



Find local maximum @1691GeV by Gradient Descent Method, with Significance 6.87264!!!(3.55985 before cut)

Background Cutting Optimization(CONT)

Signal & Background



$t\bar{t}$ Background

Characteristic of $t\bar{t}$ Background

Back to the Feynman Diagram:

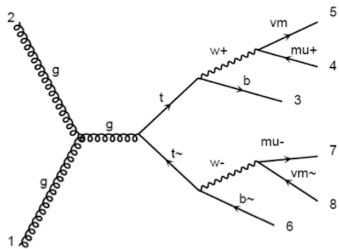


diagram 1

QCD=2, QED=4

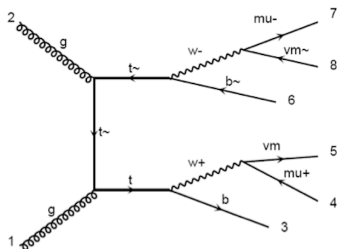
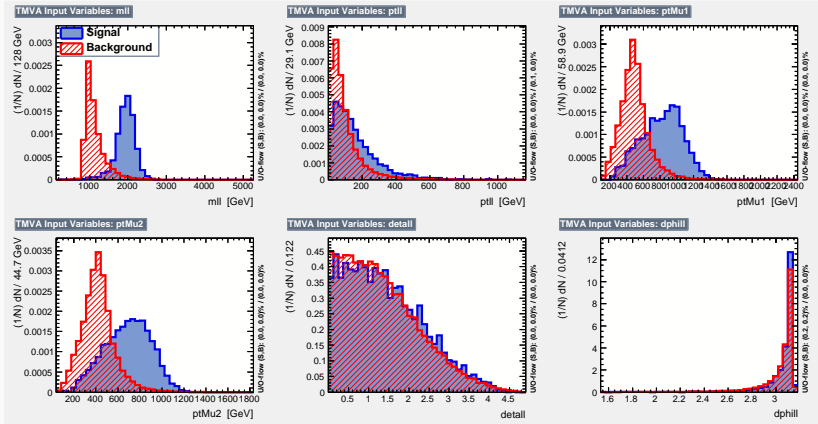


diagram 2

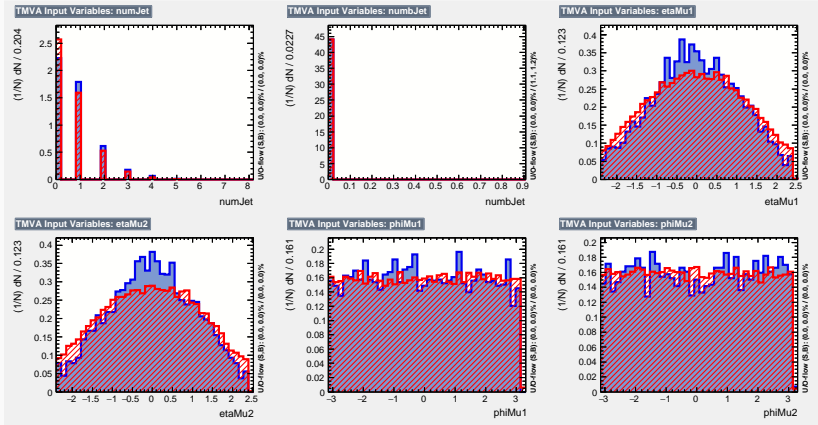
QCD=2, QED=4

Involve Jets? or $b\bar{b}$ information?

Signal/Background Info.

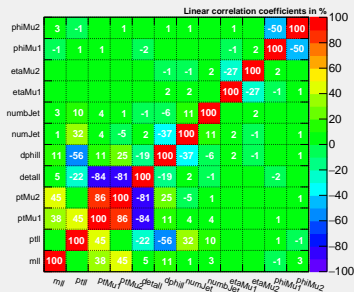


Signal/Background Info.(CONT)

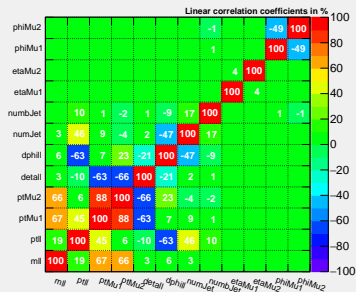


Signal/Background Info.(CONT)

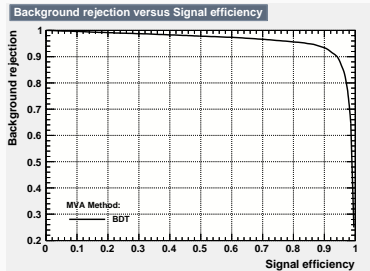
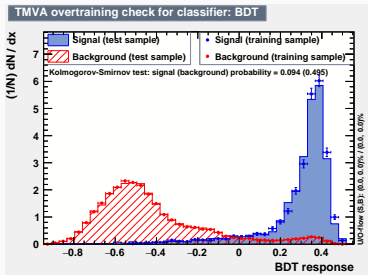
Correlation Matrix (signal)



Correlation Matrix (background)



Result???



$t\bar{t}$ contains b quarks and jets, so does the single t background. However single t contributes little, making itself neglectable. \Rightarrow (WE'RE) NOT able to suppress the $t\bar{t}$ background???

Summary

What we've managed to do:

- Run the TMVA program as well as input more parameters;
- Find the cut for M_{ll} to achieve high significance;
- Discuss about the $t\bar{t}$ background;
- Learn machine learning from nothing at all!



Thank You!